MIDDLESEX COMMUNITY COLLEGE

ACADEMIC PROGRAM REVIEW

FOR

COMPUTER SCIENCE TRANSFER
Name of Academic Program

2006-2008

Program Review Committee

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MIDDLESEX COMMUNITY COLLEGE

Academic Program Review

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Middlesex Community College

Academic Program Review

Section I: Introduction

This is an opportunity to provide background or contextual information, set goals for the program review and/or include any other introductory information that the committee believes will be helpful to the reader. Include information about previously completed program reviews, such as findings, improvements, and unfinished items.

The Computer Science Transfer Associate Degree Program at Middlesex Community College is a program for students who have as their long term goal graduation from a four year college with a Bachelors Degree in Computer Science. The program is a challenging one in that students must complete advanced courses not only in Computer Science, but in Mathematics and Physical Science as well. The demanding content of these courses provides students with a strong foundation for their future studies, as well as honing their study skills.

The program has gone through several major changes since its last Program Review in 2002. Several programming courses were changed from three to four credit courses to provide students with more time with hands on in class programming experience. This contributed to more courses being articulated to our most popular transfer school, University of Massachusetts Lowell. Also a result of the previous program review, three Intensive Values were added to one of the courses, in order to help the students complete their coursework without having to take extra courses, beyond those required by the program, to fulfill these. Another major change was the shift of delivering the more advanced three courses in the newer Java programming language. Also, two new courses were added to the program during this period. They were added to give the students extra programming experience and to give them experience in the different operating system development environment used at UMass Lowell, the school a majority will transfer to. Finally, in 2007-2008, we piloted the implementation of Facilitated Study Groups (FSG's) for an early course that many students struggle with. The FSG's have been very successful. The course with a well attended FSG had both a significantly higher retention rate and significantly fewer D and F grades than previous semesters of the same course.

To implement many of these improvements, the faculty was trained in and courses were redesigned with the new programming language. Courses were also redesigned to meet the Intensive Values requirements, as well as being infused with content improving employability skills.

In the five years since the last program review, the external environment, including the job market, perceptions of job availability, and student interest in computer science, has changed dramatically. In 2002, we were increasing the numbers of sections offered of each class – in the last few years we have had to reduce numbers of sections to the extent that we have offered some of the advanced classes only once per year. In a recent eWeek article (http://www.eweek.com/c/a/Careers/Where-Did-All-the-Girl-Geeks-Go/), Dr. Stephen Bloch, a professor of Math and Computer Science at Adelphi University, says, "computer science degree enrollments have been 'in the toilet' since 2001…In 2001, the dot-com bubble burst and everyone decided there were no jobs in this field...in the last five years, they have been desperate for people to hire." We believe that the lowest enrollment dip that began a couple of years ago has reached the advanced classes this year, but that, as evidenced by stronger enrollments now in beginning classes, this decline is starting to reverse. We will be offering more beginning sections in the summer and in the evenings to serve a larger range of students and to generate more interest in the program.

The success of the program is measured best by our successful transfer rate as opposed to our graduation rate. An overwhelming majority of students in the Computer Science program successfully transfer to a four year degree college before they complete the program requirements. We see this as good evidence that these students feel well prepared to enter the Computer Science bachelors programs for which our program is the foundation.

Section II:Mission and Goals

1. *State the mission of the program. Please indicate if the mission statement is new or has been significantly revised as part of a prior program review process.*

   The Computer Science Transfer Associate Degree Program prepares students for the computer science and software engineering professions by enabling them to transfer with advance standing into baccalaureate Computer Science programs. Emphasis throughout

the program's duration is placed on effective communication skills, strong conceptual understandings, the application of math and science to solve programming problems, and the use of up-to-date tools and appropriate programming techniques and skills to develop and execute computer programs. The Computer Science Transfer Associate Degree Program provides a blend of computer science and math courses and a strong core curriculum in general education. In addition, graduates should be able to work effectively on mixed teams of professionals to accomplish a common goal, and communicate effectively, both orally and in writing to technical and business personnel.

2. a. *What is the relationship of the program's mission to the overall mission of the College as adopted by the Trustees and approved by the BHE?*

MCC Mission: Middlesex Community College is … committed to providing educational programs and services that support personal growth and economic opportunity for its diverse student population. Dedicated to student success, the College provides excellence in teaching, personal attention, and extensive opportunities for exploration and growth. Closely linked to the fabric of the community, Middlesex's partnerships with school, business and service organizations provide leadership in economic and community development and foster a culture of civic engagement and responsive workforce development. The College's state-of-the-art programs in the liberal arts, basic skills, and more than fifty career and technical fields respond to student and community needs, providing a strong foundation for college transfer, employment, professional development and lifelong learning.

The Computer Science Transfer program supports economic opportunity for a very diverse student body. Each Computer Science class and classroom provides regular opportunities for personal attention, with students participating in hands-on classroom exercises independently and with the teacher's guidance. The Computer Science program supports responsive workforce development – it has been able to change its curriculum rapidly (sometimes more rapidly than the 4 year programs that the students transfer to) to reflect state of the art programming languages and concepts, such as the recent switch to Java and Object Oriented Programming. Our graduates are prized by UMass Lowell and have been documented by a professor there as having the highest GPA of any other group of transfer students. Thus, the program is a state-of-the-art technical program that clearly provides a strong foundation for college transfer.

b. *Please explain what specific institutional goal(s) the program satisfies. You may include any goals referenced in the College*

Mission Statement or any goals illustrated in the Pillars of the College Mission Statement.

The Computer Science Transfer Program strongly supports four of the Pillars of the College Mission:

A Dynamic Learning Environment

Teaching is student-centered, emphasizing interactive learning strategies, state-of-the-art technology, workplace and community service, and the incorporation of a forward-thinking core curriculum. Online classes, tutoring and library resources give students added flexibility for learning. Vibrant co-curricular opportunities reflect a broad array of interests and encourage a strong voice in student governance.

CS classrooms are highly interactive, using problem and case based learning techniques. Our computer classrooms are equipped with personal computers, one per student in the classroom, so that each student can have a hands on experience, and industry standard software tools for software development, such as Microsoft Visual Studio for Visual Basic and C++ development, and NetBeans, and TextPad for Java development.

A Supportive, Caring Community

Classes are small, with instruction tailored to the needs of individual students. Writing, Reading, and Mathematics learning centers and tutoring in all college subjects enhance achievement, providing added personal attention and support. By accessing the academic, career and personal counseling available at both Middlesex campuses, students receive timely, individualized guidance throughout their college experience and assistance in planning the next steps in their education and careers.

Computer Science classes are limited to 18 students, with one student per computer, and a high teacher-student interaction through questions and one-on-one lab times. By contrast, similar subjects at the four year college level can be found with 200 students in the classroom, no computers, and very little interaction with the professor. CS program students are supported by peer and professional computer tutors in the math labs.

A Commitment to Excellence

Through an emphasis on effectiveness, applied scholarship and instructional innovation, faculty and staff produce dynamic curricula and creative approaches to learning. An extensive professional development program supports exploration of effective teaching techniques, new technologies, and strategies that promote student achievement and success both in the classroom and beyond. College research and ongoing outcomes assessment reinforce Middlesex's commitment to continuous improvement and responsiveness in all of its offerings and services.

Computer Science faculty attended instructional workshops and have written or rewritten course curricula to reflect new ideas in teaching

and learning. They have also augmented and updated their professional software development skills by attending courses in new computer programming languages and specializations.

In 2002, after our previous Program Review, the Computer Science faculty at that time, Lynne Band, Sylvia Yeung, Joan Kleinman, and Dale Trudo, wrote a grant and used the funds to attend software development training. The training was a week-long intensive program at Sun Microsystems in Burlington, MA. It focused on the Java programming language, and enabled faculty to maintain currency in their programming skills. This training also allowed us to significantly update our course offerings, since, as will be detailed below, the delivery language of several courses was switched to Java from C.

In the summer of 2003, Sylvia Yeung and Margaret Bleichman attended a two week intensive training at the Oracle Internet Academy, "Database Modeling and Relational Database Design" and "Oracle SQL Basics". In the summer of 2004, Sylvia Yeung and Margaret Bleichman attended a week-long workshop, "Oracle Programming with PL/SQL", and in 2005 they attended the week-long "Oracle Fundamentals of Database Administration". Based on these trainings, Bleichman developed and taught the course, "Introduction to Database Design", CS2101, and Yeung developed the courses, "Introduction to SQL", CS2111, and "Intermediate SQL", CS2112. Bleichman developed and brought through the approval process the Database Technology concentration of the Information Technology Liberal Arts and Sciences Associates Degree, which was offered as a new degree program from 2003 and 2006. Database Technology is a specialization of Computer Science and Information Technology. The degree was discontinued due to low course enrollment, which was at least partly due to the insufficient marketing of the program and our inability to run the courses at low enrollments in order to grow interest in, and awareness of, the new program. The "Introduction to SQL" course, though offered several semesters, was never run. By taking the courses of the degree that we did not offer at MCC at other schools, two MCC students graduated with this degree even after it was discontinued, one in 2006 and one in 2008.

Between 2003 and 2007, Lynne Band, Sylvia Yeung, and Margaret Bleichman each attended one or more BATEC (Boston Area Advanced Technological Education Connections) industry summits and IT Futures Workshops. These meetings provided faculty with the opportunity to sit in face-to-face discussions with software firms and learn about their needs for software engineers. One such meeting, in March of 2007, had the following goal:

> …to share best practices in industry and education partnerships and to arrive at mutual understandings and models for effective collaboration fortified with practical strategies and implementation plans.

As a result of these meetings, many of our courses now include "soft skills", such as teaming, attitude and performance. In 2003 Bleichman attended the BATEC Java Summit at BHCC to discuss methodologies of teaching the Java computer programming language with other teachers.

As part of the State Department funded "Workforce Development and Distance Learning Partnership", Margaret Bleichman traveled to the Ukraine to the. She delivered five seminars at the Academy of Management and Information Technology, including "Introduction to the Use of Interactive Discussion Boards in Web Based Courses", "Topics in Online Course Development", "Continued Topics in Online Course Development", and "American Pedagogical Techniques".

In 2004, Sylvia Yeung and Margaret Bleichman attended the MCC Online Course Development course. As an outcome, each developed an online version of a different Computer Science course. Yeung developed the online "Introduction to Computer Science", CSC101. Bleichman developed the online "Programming I", CSC151. A faculty member also participated in a year of professional development seminars given by the MCC Teaching, Learning, and Reflection center (TLRC) which covered a broad range of topics, including collegial collaboration using new modes of teaching, learning, and assessment.

In 2003, Margaret Bleichman attended the Project Based Learning (PBL) workshops and developed PBL units to augment the Data Structures (CSC257) and Programming I (CSC151) courses.

In 2005-2006, Sylvia Yeung and Mary Beth Scott, one of our adjunct faculty, attended BATEC's Course Curriculum Development workshop for one semester to rewrite course curricula for the "Linux Fundamentals" course (CSC156) and to infuse National Workforce Center for Emerging Technologies (NWCET) Skills Standards and employability skills such as teaming and project-based learning.

In preparation for a new Computer Science related program, Computer Forensics, Sylvia Yeung attended a week long "Computer Forensics Boot Camp" in summer of 2007, after which she developed and taught the "Computer Forensics I" course.

Margaret Bleichman is a member of the Carnegie Community of Practice, a group of faculty in disciplines across the college, who together explore the scholarship of teaching and learning.

Section III: Data

The Institutional Research Office will provide a significant portion of the data. Your committee is encouraged to request additional relevant information from Institutional Research and to develop and conduct alternative assessments as well. Some examples of assessments that the committee may choose to implement are student focus groups and/or student surveys. Input from relevant internal groups such as Advising, Admissions, and/or connected departments will also be necessary. Please include a copy of the data from Institutional Research and all committee-developed surveys or focus questions in the Appendix of the review.

3. a. *Please note important trends, patterns and issues that emerge through the enrollment, academic progress and retention data. (Data from Institutional Research Office)*

b. *Please comment on significant information that emerges from the Student Transfer and Employment Follow-up data. (Data from Institutional Research Office and Department Records)*

Why Have Our Enrollments Decreased?

Our data shows a decline in applications from a high of 192 in Fall 2001, to a low of 53 in Fall 2005, while the college-wide trend increased. The decline in enrollment is not a function of, or a reflection on, MCC's Computer Science Department, but is a nationwide trend. On April 10 of this year, Greg Avery of the Daily Camera in Boulder, Colorado stated in an Internet article:

> Where have all the students gone, and how can we get them back?
>
> They're questions that have roiled university computer-science and computer-engineering programs across the country in recent years.
>
> In 2006, undergraduate enrollment nationwide in computer studies was half of what it was in 2000. Graduate-level programs also are shrinking as the trend works its way through academia.

> The industry's bust five years ago -- followed by rounds of layoffs and hundreds of startup companies disappearing -- tarnished the profession in the eyes of many outsiders. More recent trends of sending some technology jobs overseas only solidified that perception.
>
> Many high schoolers, influenced by their parents and media reports, are seeking out other disciplines to avoid professional downsizing later, experts say.
>
> A slight uptick in freshman declaring an interest in computer majors for the 2007-2008 year has observers encouraged that the slide has stopped.
>
> But the great irony is that the enrollment declines hit bottom just as technology employers have grown healthy enough to hire, and predict continued growth.

(http://www.redorbit.com/news/technology/898135/schools_faced_with_an_enrollment_drop_in_computerscience_students/index.html?source=r_technology)

Clearly the problem in our low enrollment numbers will be resolved in the near future, as students respond to the technology industry's demand for workers and apply for admission to computer science programs.

The numbers for the "New Student Full Time Equivalent Enrollment Trend", "Total Student Head Count Enrollment Trend", and "Total Student Full Time Equivalent Enrollment Trend" should be interpreted as stated above.

Who Are Our Students?

The data shows that our students are between 18 and 49 years old, with the majority (greater than 50%) in the 20 to 24 age range. Less than 10% of our students are older than 30. College-wide data shows an average of more than 25% of students older than 30. Why the difference? It may be because the Computer Science Transfer Program does not have enough enrollments to offer evening courses that are more accessible to older adults who work around a school schedule with their full-time job.

As with Science, Technology, Engineering and Math (STEM) enrollment data nationwide, our gender enrollment is heavily weighted toward males. (See Barker, L. J., Guzdial, M., Irani, L. and Zur, E., (2005),

Contrasting Women's Experiences in Computer Science at Different Institutions. Proceedings of the 36th SIGCSE technical symposium on Computer science education, pages 63-64 and Beyer, S., Colar M., DeKeuster M., Holcomb C., and Walter, K., (2005), changes in CS Students' Attitudes Towards CS over Time: An Examination of Gender Differences. Proceedings of the 36th
SIGCSE technical symposium on Computer Science education, pages 3 92-396.[1]) In the last five years, we averaged 16% women in our program.

The solution to this problem is complex and beyond the scope of our department. However, Margaret Bleichman has taken the initiative to work to increase our number of women students through her "Women in Technology" program. Each spring in the last two years, she created panels of women with STEM careers and allowed female students an opportunity to interact with them. The informal feedback from female students has been very encouraging. We hope to continue to expand this program by continuing the panel discussions and also opening connections with IBM Corporation's "Women in Technology" program, a successful program that has increased IBM's number of women in the technology field.

Ethnicity in our program parallels the enrollment college-wide numbers with the exception of the percentage of White and Asian students. Our number of white students is 13% less and our number of Asian students is 12% higher than the college as a whole. The large number of white and Asian students and low number of other ethnicities again is reflected nationwide. [2] Since the previous program review, however, we have seen an increase the number of black and Hispanic populations in computer science. The increase in Hispanic students may be explained by an increasing nationwide trend. [3].

Placement Exam Data

Our student population has a smaller percentage that place into "Basic Writing" than the college as a whole and a larger percent who place into English Composition I. This indicates that we do not have to adjust the requirement for a co-requisite with English Composition I in our introductory programming class, Introduction to Computer Science. (The co-requisite is due to a Writing Intensive Value in this course.)

We do have a higher percent of students who place into Basic Writing ESL than the college as a whole (In 2005, 5 % versus 1.2 %.) This represents a very small percentage of our students, and may not be

addressed directly by our department. However, we may want to begin to dialog with the ESL Department about our students, and how we can best assimilate them into our program.

In Fall 2005, as compared to the college as a whole, the Computer Science Department had fewer students who tested into "Required Reading" courses and more students who tested into "No Reading Courses".

A larger percentage of our students test into Algebra II and Intermediate Algebra than the college as a whole, while we have smaller numbers who test into Fundamentals of Mathematics, than the college as a whole. Since our students are very mathematically oriented, this statistic is easily understood.

Enrollment Trends by Campus

We have a similar percentage of students in our program located on the Bedford campus, as does the college as a whole. There is about a 20% less enrollment in our Lowell campus, however, compared to the college as a whole. Additionally, there are two times as many of our students who are enrolled in both Bedford and Lowell than the college as a whole. These two final statistics probably result from the fact that all of the programming courses in the program are offered at the Bedford campus, while only Introduction to Computer Science and Programming I are offered in Lowell. All students enrolled in the program must come to the Bedford campus to attend upper level courses. If the enrollment trend in computer science increases, as projected nationwide, we may begin to offer upper level sections to our Lowell campus.

Day or Evening?

Enrollment data shows that we have more of our students enrolled during the day and day and evening than the college as a whole. We also have only 1% of our students enrolled in the evening versus the college wide 32% figure. With a declining population, since the last program review, we were forced to close all of our evening sections. We had hoped to allow this segment of the population access to the program through Web courses. However, our enrollment in online sections has been so low; the sections have not been able to run, effectively shutting out this population from our program. Again, as stated above, if the trend toward increasing computer science enrollments occurs at MCC, we can again offer evening sections (as well as online sections). We will offer an evening section of

Programming I in Fall 2008, as well as sections of Intro to Computer Science and Programming I in Summer 2008.

Since we do not offer evening courses and our enrollment in the program as a whole is small, we have very, very low numbers of courses taught by adjunct faculty. The majority of classes are taught by full-timers.

Student Credit Load Trend
Over the past five years, nearly 72% of our students have taken over 9 credits. The college as a whole averaged around 57% in that category. We also average more students taking 15 or more credits in that time period as compared to the college as a whole (11.5% versus 7%). This may be explained by the fact that ours is a transfer program and students are motivated to take as many courses as possible, knowing they have at least 2 ½ more years ahead of them at the baccalaureate level.

Successful Course Completion Rate Trends
For the program as a whole during the Fall 2005 semester, we average about the same rate of successful completion than the college as a whole. We had a slightly higher (3.9%) rate of course withdrawals, but our number of failed courses was almost half that of the college as a whole. This may be due to the fact that all of our courses are taught by full-time faculty who are able to hold office hours to offer additional help to students. We also benefit from having a dedicated tutor and several peer tutors that the Academic Resource Department provides for our program.

On a course by course basis, we have low failure (5%). Our average withdrawal rate over the past five years was 14.9%. It should be noted that Programming I averaged almost a two times higher number of withdrawals than any other course. This may be explained by the fact that this is the first "non-introductory" programming course and not all enrolled students may be prepared for the rigorous nature of the subject.

Graduates
Along with the trend toward lower enrollments in the past five years, it would be expected that our graduation rates would decline, as well.

Transfer Colleges
By far, the majority of our students transfer to the University of Massachusetts at Lowell. This fact will enable us to continue to work

on the Articulation Agreement between the two colleges and work on facilitating the transfer process for our students (perhaps by preparing a FAQ website for students transferring to this institution). A number of students are also transferring before they graduate from the program. This would explain the low number of graduates from our program versus the number of enrollees. Many of our students graduate one course short of completing their Computer Science course requirements. Since our enrollments have fallen in the last few years, there are three courses (2 Computer Science courses and 1 Mathematics course) that are only offered one semester per year. Because of this, some students, instead of remaining at MCC an extra semester to take this last course, choose to transfer and continue their studies at the four year level.

A few years ago, the late John Sieg, Professor of Computer Science at UMass Lowell, tracked students transferring into UML's Computer Science program from several community colleges. His statistics showed that Middlesex Computer Science transfer students had higher UML g.p.a.'s than any of the other schools' students. We interpret this to mean that our program has given our students a solid foundation upon which to continue their studies at UML, and that it has been well aligned with UML's program.

The Chair of the department, Margaret Bleichman, meets with the transfer representative of the Computer Science department at UML every couple of years to make sure that the programs are aligned and to renew our transfer articulation agreement.

Employment

A very, very small number of students (between 1 and 5) were employed after completing the program and none were unemployed (attending transfer institution?) This data for employment is explained by the fact that ours is a transfer program and not intended to result in employment after graduation.

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[1] Enrollment Differences by Gender in Computer Science, Computer Information Systems, and Information Technology at Youngstown State University, www.cis.ysu.edu/~alazar/pdf/creuProposal2006.pdf

[2] Count Me In, www.odu.edu/ao/instadv/quest/countmein.html

[3] Computer Science Department Academic Review, University of Southern California, February 6, 2004, http://www.cs.usc.edu/miscellaneous/review/cs-self-study.pdf.

c. *Please summarize findings from student surveys, student focus groups, and/or other types of surveys and focus groups the Committee chose to undertake. (Data from surveys and/or questions developed by the Committee)*

The Computer Science faculty surveyed their advanced students in the spring semesters of 2006 and 2007 to determine what paths the students planned to take. These students include those in Programming II and Data Structures -- Programming III students were also taking Data Structures and so were surveyed there. Our results showed that most students planned to graduate from Middlesex and then transfer to a four year college, usually UMass Lowell. However some ended up transferring before graduating, and some ended up at MCC longer than expected to finish up course requirements.

75% of Programming II students (2006 and 2007) intended to return to MCC the next year; 12.5% expected to transfer; 12.5% were unsure. Of these same students, 63% expected to graduate from MCC, 31% expected to transfer without graduating from MCC.

Of the 2006 Data Structures students, 50% graduated MCC, 19% transferred without graduating. It is also interesting to note that of the graduates, one took a degree in Liberal Arts and Sciences, and two took degrees in Liberal Studies. These students completed the required Computer Science courses, but opted to not complete the Math requirements and graduate with a degree that does not require these advanced math courses.

90% of the 2007 Data Structures students intended to graduate from MCC (these included 20% who intended to transfer to a four year college before graduating from MCC and then "send back" a course to graduate from MCC as well); 10% intended to transfer to a four year college without graduating from MCC. However, as of Spring 2008, of those same students, 54% have graduated MCC (18% transferred to UMass Lowell and then graduated MCC). Data Structures has typically been taken in a student's final semester at MCC. A year after taking Data Structures, almost half the students are either still completing other courses, usually Math courses.

Due to low enrollments, Data Structures was run only as an independent study course in 2008, with two students. Of these, one graduated and is transferring to UML; the other is transferring the UML without graduating from MCC.

What seems to be a trend is that students finish up their Computer Science requirements, but then stay at MCC to complete their Math requirements, usually Discrete Math and Calculus I and/or II. Some students get discouraged or want to move on, and either switch to other majors in order to be able to graduate MCC with another degree or transfer several courses short of the CS degree. The course most often not taken before transferring was MAT250, Discrete Math.

Another question on the survey asked whether students felt that the Computer Science program at MCC prepares them for transfer into a Bachelor's degree CS program. All students in all classes said yes, except one who had heard that the program at UML was more difficult, and expressed some concern.

The survey and comments students wrote about the CS program at MCC can be found in Appendix C.

Section IV: Program Analysis

Target Populations:

4. a. *Is this program intended to serve a target population(s)? Please explain.*
Yes, the Computer Science program serves a specific population of students who intend to transfer to a four year college to pursue a Computer Science degree. These students plan to become software engineers, programmers, and other technical positions that require a Computer Science bachelor's degree. Our students have a variety of reasons for not matriculating directly into a four year program, including economic means, college skill level, and linguistic barriers. This program provides these students with approximately the first year and a half of coursework that is normally completed in the four year program. The students benefit from being able to complete this coursework in greatly smaller class sizes *(at our college a maximum of 18 vs. a typical 4 year institution's first year introductory class of 100 or more)*, greater academic support through peer and professional tutoring, greater availability of faculty, and the possibility of taking a lighter course load over a longer period of time, which helps students

who work part and full time jobs to support themselves during their studies.

In the last few years, we have seen several students who have been employed in the software or IT industry for many years, but who never studied computer science formally, enroll in our Computer Science program because they have found either that they are now required to have a Computer Science bachelor's degree to advance in their fields, or they want to "fill in" the skills and knowledge that they have missed by being self-taught or on-the-job taught.

b. Are there plans to recruit/market for this program by targeting any new or different groups? Please explain. Are there additional student recruitment and/or marketing efforts in which program faculty would like to be involved? Please be as specific as possible.

Currently the program draws students who identify as Computer Science majors when they enroll at the college. A few students who enroll in Introduction to Computer Science as non-declared, Liberal Studies, or Engineering majors have switched to Computer Science after taking the class. The faculty have tried to bring new students to the program with several initiatives.

In Spring of 2006, flyers highlighting the benefits of a career in Computer Science and the MCC Computer Science program were mailed to all Liberal Studies students or non-declared students, approximately 750 students in total. (See Flyer in Appendix D.)

The department added a new course to its offerings, "Introduction to Video Games**"** in Fall of 2003. The course is not required by the program, but is geared to a wide audience of students interested in video game development. Some are Computer Science students, others are from other majors. The intent of this type of introductory course is to potentially draw more students in to Computer Science who might not originally take the Introduction to Computer Science class. The course has been very popular, with two sections filling each semester.

In Fall 2006 we undertook a new outreach to students on the first floor hallway of Henderson Hall with the goal of raising awareness of the Computer Science. Posters a new bulletin board dedicated to the Computer Science program was installed. An active bulletin board program provides interesting and attention-getting articles, and posters on the hallway walls encourage students to investigate careers in Computer Science.

In Fall 2006 we also began a three year Computer Forensics Advanced Technology Education (CFATE) grant. This project is a collaborative effort involving three other community colleges and University of Massachusetts Boston to develop an Associate Degree and a Certificate Program in Computer Forensics. A Computer Science faculty member developed the first course in this program, "Introduction to Computer Forensics", during Summer 2007 and began teaching it in Fall 2007. Although this program is separate from the Computer Science program, it is closely tied. It gives Computer Science students an opportunity to experience a specialty in the field and add a valuable set of skills to their resumes. It can potentially also serve to draw more students into Computer Science.

Another initiative geared towards encouraging more students to enter Computer Science is the broader STEM (Science Technology Engineering and Math) initiative at MCC. Starting in Fall 2005, Computer Science Faculty have been involved in several STEM activities geared towards recruitment and retention of CS majors. In addition, workshops were run for faculty, students, and academic advisors to address the issue of gender and science. Two panels were organized with women scientists presenting their stories to an audience of students, staff, and faculty. In 2007, through the Louis Stokes Urban Mass Alliance for Minority Participation (LSAMP) grant, faculty are involved in creating STEM activities to support underrepresented minority students in STEM majors, including Computer Science. In Fall 2007, a pilot program was begun with one section of Programming I that offered a Facilitated Study Group option to students.

c. Are there plans to change or add to strategies currently in place to assess the program's fit with student interest and market demand?

The MCC Computer Science program has been designed to fit tightly with the Computer Science at UMass Lowell, the college that a majority of our students transfer to. Because this fit is critical to the success of our students and of our program, we place a greater emphasis on maintaining our articulation with UMass Lowell, and other colleges, than with market demand. One example that illustrates our program's early response to market demand is that the higher level programming courses, which used to be taught using the C++ programming language, have switched to the Java programming language. While either language can be used to teach the critical concepts, Java is the language that is gaining industry share, particularly in internet related software development. This switch actually predated a similar switch that is occurring at some four year campuses, where there is less flexibility and curricular changes such as

this occur at a slower rate. At UMass Lowell, the faculty and courses are split between the two languages, and students in many courses can use either one to complete required assignments. Of additional interest is the fact that in 2004, the delivery language for the Advanced Placement Computer Science Exam was changed from C++ to Java.

d. Are program faculty and staff currently working with the Academic Planning Center or other areas of the College to interest students in taking courses in the program? Describe these interactions and the roles that the parties play.

Diane Malley-Parcella, Director of Academic Planning, attended a couple of CET division meetings (the CS department was formerly part of the CET division). At one such meeting, CS faculty demonstrated what students actually learn and do in an Introduction to Computer Science course. This helped her better direct students to Computer Science. The department chair contacts Diane Malley-Parcella whenever the department wishes to share information about CS courses with Academic Planning. She distributes this information to the Academic Advisors.

We have requested that all Computer Science majors be assigned one of the three Computer Science faculty members as their advisor.

Similar to several workshops involving faculty, staff, and students, Margaret Bleichman led a "Gender Chip" workshop with a group of academic advisors to raise and discuss the issue of advising female students to pursue the Computer Science major. Feedback to this workshop was unanimously positive and indicated that advisors gained tools and perspectives necessary to help increase the number of female students enrolling in Computer Science.

In the past, the department chair, Margaret Bleichman, met with the academic advisor who was the liaison to Computer and Engineering programs, Wendy Russman-Halperin, each semester, going over program requirements, and planning strategies for students to best meet these requirements – the goal being for them to transfer as many courses as possible. They produced a document, "Guidelines for Advising Computer Science Students", that is still used as a critical reference tool for advising Computer Science students. A most useful part of this document is the color-coded "MCC Courses That Fulfill Gen Ed Requirements at UMass Lowell" that is used to choose elective

courses at MCC that will best meet UMass Lowell's graduation requirements.

CS Faculty set up a table on Main Street on the Bedford campus at "Technology Day" in 2005, where they demonstrated software programs written by students in Introduction to Computer Science and in Programming III.

The department chair has also met with Academic Advisors to review the requirements and sequencing of the Computer Science program.

e. *Are there additional student recruitment/marketing efforts in which program faculty and/or staff would like to be involved? Please be as specific as possible.*

Program faculty will continue to be involved in student recruitment at the regional high schools, of undeclared MCC students, and of women.

f. *Please comment on any Advanced Placement (high school) or Articulation Agreements (4-year institutions) that apply to your program. Are the agreements current and signed by all partners? What percentage of students in the program takes advantage of each agreement?*

A great majority of our students transfer to UMass Lowell (43%), with whom we have a long standing and up-to-date articulation agreement. Many of our students who transfer to UMass Lowell take advantage of this agreement, since it offers them immediate acceptance into the Computer Science major at that school (other students have to apply to the major and may not get accepted), and guaranteed transferability of 11 specific Math and Science courses required by our program (in CS, Math, and Science) as well as 6 courses in other disciplines, for a total of 61 transferred credits. We also have signed up-to-date agreements with Salem State College. Our department has been working with UMass Boston on a similar articulation agreement for a couple of years.

We have noticed a significant trend of MCC Computer Science students to transfer to a four year institution before graduating MCC, often with only one or two courses left. Some of these students take the course at their transfer institution (i.e. UML) and "send back" the course credit, completing their requirements and subsequently receiving their Associates Degree from MCC. Some will continue on to their Bachelor's Degree without completing their Associate's:

72% transferred to four year institutions before graduating

93% transferred to four year institutions after graduating
This data must be considered whenever completion rates are quoted and/or discussed, since these students are very much succeeding (transferring, attaining bachelor's degrees) even though they may not be staying at MCC to graduate.

We are currently working on an articulation agreement with Lowell High School and Cambridge Rindge and Latin School to give credit for their Visual Basic course as equivalent to our Introduction to Computer Science course, CSC101. The probable outcome would be for the student to be awarded this credit after completing the subsequent course in the sequence, Programming I, with a grade of B or higher. We are working on similar agreements with Greater Lowell Technical High School.

Our program awards credit to those students who complete the Advanced Placement Computer Science exam. We have had two students in the last six years who have been awarded this credit.

External Perspectives:

5a. *Based on a review of other college catalogs, list the colleges in our general area that have similar programs and comment on significant differences from the ones we currently offer that bear further exploration.*

Three community colleges in our geographic region that have similar programs are Northern Essex, Mass Bay, and Bunker Hill. Northern Essex's program is not a transfer program, so it does not have the math or upper-level programming intensity that students need to transfer to a four-year institution. Bunker Hill and Mass Bay both have transfer capability built into their programs. Bunker Hill's program is 62 credits, while Mass Bay's is remarkable at 73 credits. Both are good programs, similar to ours at MCC. Mass Bay, however, does offer a programming elective, either database management or networking, allowing students to broaden their Information Technology skills. While this is an excellent idea, it is impractical to add to our program for two reasons. First, it would add more credits causing our students to remain at MCC longer. Second, since it would not transfer to UMass Lowell, it would not aid them in their (ultimate) pursuit of a software engineering degree.

5b. *Based upon the committee's knowledge of institutions beyond our geographical area that have exemplary programs or are known for*

their 'best practices,' comment on significant similarities or differences at MCC and in what areas that bear further exploration.

One institution known for its 'best practices' in our field of study is Belleview Community College in Bellevue, WA. They are well known for their development of skills standards for information technology.

In some areas, their program is more intense. Their programming courses are five credits, while the majority of ours are four. They have a special course in data warehouses, e-commerce, and systems development. Advanced and current topics that are definite program enhancements. They also have ten credits in an independent study course which gives students directed readings, special projects, and individual study with a faculty member. While this is an exemplary idea, as stated in question 5a above, it would add credits to our program, which again would not transfer to UMass Lowell.

6. *Please describe mechanisms or procedures currently in place to monitor changes in the job market and review the program's currency and "fit" with the educational interests and needs in our region. Explain how these groups have contributed and/or impacted the program's offerings.*

   a. *Relevant external parties, such as advisory groups, corporations/agencies, professional groups, outside licensure/accrediting bodies, etc. If there is an advisory committee in place, please comment on the frequency of meetings and the contributions/impact the committee has had on the program. Include names of members and minutes of the meetings in the appendices of the program review.*

The Computer Science degree is a transfer degree, and as such it is much more appropriate to have the program impacted by transfer articulation needs, rather than by an industry advisory group.
For further information see question 4c above.

b. *Relevant internal groups or individuals, such as other departments, programs or areas at the college that: (1) utilize your courses as prerequisites for their courses and/or program or (2) supply prerequisites for your courses.*
(explain impact here)

(1) The Engineering Science Transfer program utilizes two Computer Science courses. The program requires CSC151 Programming I, which has as its prerequisite CSC101 Introduction to Computer Science. For

those Engineering students planning to major in Electrical and Computer Engineering (particularly at UMass Lowell) the Engineering program accepts one of the following Computer Science courses as a course substitution for another required course: CSC252 Programming II, CSC201 Computer Organization and Assembly Language, or CSC156 Linux Fundamentals. The computer science and engineering programs have collaborated on the projects and intensive value components of CSC101 and CSC151.

The Information Technology concentration in Liberal Studies degree requires CSC101 Introduction to Computer Science, and CSC156 Linux Fundamentals.

The Physical Science and the Life Science concentrations in Liberal Arts and Sciences requires a choice of either CSC101 Introduction to Computer Science, or CSC151 Programming I.

The Biotechnology Technician Associate in Science degree program has recently added an option of taking CSC101 Introduction to Computer Science or CSC151 Programming I instead of CAP103 Computers for Technology.

(2) The Math and Science Departments supply several required courses for the Computer Science program.

The mathematics courses are: MAT185 Precalculus for Science I, MAT190 Precalculus II, MAT290 Calculus I, MAT291 Calculus II, and MAT250 Discrete Mathematics. Computer Science students are the only students that are required to take MAT250 Discrete Mathematics, which was developed in collaboration with faculty from the Math Department. It would be interesting to investigate a collaborative lesson or project between Discrete Mathematics and Data Structures, since the two courses share some conceptual foundations.

The science courses are: PHY171 Physics for Engineering Science I and PHY171 Physics for Engineering Science II.

c. *Other populations (i.e., students, alumni, community members, cooperative education supervisors, practicum supervisors, service learning supervisors, community agencies).*
n/a

Section V: Curriculum

Program Student Learning Outcomes (PSLOs)

7. a. Identify your Program Student Learning Outcomes

Software Development: Students will be able to apply fundamental concepts of programming languages and software development to solve a diverse array of problems and recognize these concepts in different languages.

Professional Skills: Students will be able to effectively work with others to design, develop, evaluate, and present solutions to business and software engineering problems. Students will be able to update their skills when new programming languages and tools emerge.

Problem Solving: Students will be able to analyze problem, gather appropriate data, use logic to solve, predict and analyze results for relevance, accuracy, and consistency.

Solution Patterns: Students will be able to recognize solution patterns of common problems and apply them to new challenges.

Communication: Students will be able to communicate clearly, accurately, and succinctly through written and verbal means.

b. Please provide your program's timeline for ongoing, annual assessment of its PSLOs.

YEAR	PSLO
2007-08	Communication
2008-09	Problem Solving
2009-10	Software Development
2010-11	Professional Skills
2011-12	Solution Patterns
2012-13	Communication

c. If applicable, discuss any changes you have made to your PSLOs and/or the ways in which the courses in the program support those PSLOs since your last program review.

Between 2003 and 2007, faculty attended one or more BATEC (Boston Area Advanced Technological Education Connections) industry summits and IT Futures Workshops. As a result of

these meetings, many of our courses now include “soft skills”, such as teaming, attitude and performance.

When Computer Science courses were redesigned to meet the Intensive Values requirements, they were also infused with content improving employability skills. These modifications help support the Communication and Professional Skills PSLO’s.

d. *Map the way in which your program provides opportunities for students to progress towards achievement of each Program Student Learning Outcome, by noting in which courses the outcomes are **Introduced (I)**, **Developed (D)**, or where students are expected to demonstrate **Proficiency (P)**.*

Curriculum Map I:

Course Opportunities for Student Achievement of PSLOs

PSLO	Course	Course	Course	Course	Course	Course	Course
	CSC101	CSC156	CSC151	CSC252	CSC253	CSC256	CSC257
	Intro to CS	Linux Fundament	Prog I	Prog II	Prog III	Assembly	Data Struct
Communication	I	D	D	D	P	P	P
Software Development	I	D	D	D	P	D	P
Work w/Others	I	D	D	D	P	P	P
Problem Solving	I	D	D	D	P	P	P
Solution Patterns	I	D	D	D	P	P	P

e. *Please comment on the **sequencing of** opportunities for students to develop and achieve each PSLO within the program, as noted on Curriculum Map I.*

Except as noted below, the Computer Science courses are taken in sequence:

CSC101 Introduction to Computer Science
CSC151 Programming I
CSC252 Programming II
CSC253 Programming III
CSC257 Data Structures

Some students may skip CSC101 if they have previous programming experience and with permission of the teacher.

CSC156 Linux Fundamentals is not a sequenced course – it may be taken at any point in the program after the student has completed CSC101 Introduction to Computer Science or CSC151 Programming I. No subsequent class depends on it as a prerequisite.

CSC201 Assembly Language and Computer Organization may be taken any time after CSC252 Programming II, but no subsequent class depends on it as a prerequisite. Also, it does not require group projects.

f. *On the following pages, please indicate **how each PSLO is attained** and **how the attainment of each is assessed**. If the strategy for attainment of a PSLO is contained within a particular course, please list the course first, with the relevant activity (or activities) listed next to each course. If there is nothing currently in place that is intended to provide for the attainment of a particular outcome or to assess the extent to which the outcome has been realized, please leave the appropriate space blank. The blanks will help to identify areas which need further development.*

	Course	Course	Course	Course	Course	Course	Course
	CSC101	**CSC156**	**CSC151**	**CSC252**	**CSC253**	**CSC256**	**CSC257**
	Intro to CS	**Intro to OS**	**Prog I**	**Prog II**	**Prog III**	**Assembly**	**Data Struct**
Communication	* Article/Web Summary * Research Paper *Essay Questions	*report *presentation *journal *Essay/lab Questions	*program prologue *essay questions *program comments *group presentation *code review	*program prologue *essay questions *program comments *group presentation *code review	*program prologue *essay questions *program comments *code review	*program prologue *essay questions *program comments * presentation	*program prologue *essay questions *program comments *code review
Software Development	*Intro to programming problems in Visual Basic	*Intermediate programming problems in Shell Script	* Intermediate programming problems in C++	* Intermediate programming projects in Java	*Advanced programming projects in Java	* Advanced programming projects in Assembly	* Advanced programming projects in Java
Work w/Others	*Intro to team programming project	*team programming project	*team programming project	*team programming project	*team problem-based learning	*team problem-based learning	*team problem-based learning
Problem Solving	*Intro to programming problems in Visual Basic	*Intermediate programming problems in Shell Script	* Intermediate programming problems in C++	* Intermediate programming projects in Java	*Advanced programming projects in Java	* Advanced programming projects in Assembly	* Advanced programming projects in Java
Solution Patterns	*Intro to programming problems in Visual Basic	*Intermediate programming problems in Shell Script	* Intermediate programming problems in C++	* Intermediate programming projects in Java	*Advanced programming projects in Java	* Advanced programming projects in Assembly	* Advanced programming projects in Java

PSLO I: Communication

Graduates of the Computer Science Transfer Program will be able to communicate clearly, accurately, and succinctly through written and verbal means.

	CSC101	CSC156	CSC151	CSC252	CSC253	CSC256	CSC257
	Intro to CS	**Linux Fund.**	**Prog I**	**Prog II**	**Prog III**	**Assembly**	**Data Struct**
Communication	* Article/Web Summary * Research Paper *Essay Questions	*report *presentation *journal *Essay/lab Questions	*program prologue *essay questions *program comments *group presentation *code review	*program prologue *essay questions *program comments *group presentation *code review	*program prologue *essay questions *program comments *code review	*program prologue *essay questions *program comments * presentation	*program prologue *essay questions *program comments *group presentation *code review

- Describe how this Program Student Learning Outcome is **assessed for proficiency** at the **program level**.

To assess the Written Communication PSLO, we looked at Program Prologues, Program Comments, and Presentation reports. The Program Prologues are short, highly formatted prefaces to actual programming code that describe what the purpose of the program is, explain the history and nature of modifications to the program, and examine what areas the student found challenging and how these problems were solved. The program comments are short notes sprinkled throughout the program code that explain specific lines of programming code. The Presentation reports are the written products that are submitted in conjunction with presentation assignments that usually involve PowerPoint presentations.

For our assessment, we gathered 30 documents. We took 10 computer programs each from the Data Structures and Assembly Language classes (for a total of 20 computer programs). We took a full set for a given assignment for the entire class. Each of the three faculty members applied the same rubric to each of the 20 program documents. We also assessed 10 reports that were submitted for the Assembly Language course. The average score on the computer program communications was 6.82 out of a full score of 10. The average score on the reports was 69 out of 100. To assess the Verbal Communication PSLO, we took the parts of the professor's rubric from the group presentations of the Linux class that were relevant to this PSLO, namely the "Eye Contact" and "Presentation" scores. (The other parts of the rubric had to do with content and other items not directly related to the Communication PSLO.) The average score on these presentations was 6.53 out of a total score of 12.

What does the program's data analysis reveal about student achievement of this PSLO within the program?

The Computer Science curriculum is very dense -- it does not allow for oral presentations in the advanced courses generally taken in the last year. The students are assessed for oral communication in the middle of the program. In the Linux Fundamentals course student presentations were assessed for content and quality, as well as for eye contact and elocution. The average score for the latter was 6.53 out of 12. This suggests to us that more can be done to improve students understanding of what a good presentation entails.

See Appendix B for Assembly Language Report, Hardware Report, and Linux Fundamentals presentation rubric.

What curricular and/or instructional changes are planned within the program as a result of this data (if any)? Consider:

- **The scope and sequence of Introductory, Developing, and Proficiency level student learning opportunities**

- **The adequacy of the range of learning experiences and assessment methodologies that your program offers to meet student learning needs**

We have several recommendations geared towards improvement student achievement of this PSLO:

1. Show and discuss the rubric that will be used on the assignment with the students when the task is assigned.
2. Modify the rubric to reflect a better distribution of points that would match our criteria of a "good report".
3. Show a video of "good vs. bad" presentations skills to the students when the presentation projects are assigned.

We believe that our students need more experience with the type of presentation skills and written communication that will be required of them as Computer Science professionals. We will examine other opportunities in our courses for our students to practice these skills.

8. **Institutional Student Learning Outcomes**
(see **Appendix A** for detailed listing of MCC's Institutional Student Learning Outcomes)

a. Please provide your program's timeline for ongoing, annual assessment of MCC's ISLOs that are supported to proficiency within your program.

YEAR	ISLO
2007-08	Social Responsibility; Personal and Professional Development
2008-09	Critical Thinking; Global Perspectives
2009-10	Knowledge and Skills; Communication
2010-11	Social Responsibility; Personal and Professional Development
2011-12	Critical Thinking; Global Perspectives
2012-13	Knowledge and Skills; Communication

b. If applicable, discuss any changes you have made to your program's support of MCC's ISLOs since your last program review.

c. As appropriate, map the way in which your program provides opportunities for students to progress towards proficiency level of MCC's Institutional Student Learning Outcomes, by noting in which courses outcomes are **Introduced (I)**, **Developed (D)**, or where students are expected to demonstrate **Proficiency (P)**.

Curriculum Map II:
Program Opportunities for Student Progress toward ISLOs

	Course	Course	Course	Course	Course	Course	Course
	CSC101	CSC156	CSC151	CSC252	CSC253	CSC256	CSC257
	Intro to CS	Intro to OS	Prog I	Prog II	Prog III	Assembly	Data Struct
Knowledge & Skills	I	D	D	D	P	P	P
Critical Thinking	I	D	D	D	P	P	P
Communication	I	D	D	D	P	P	P
Global Perspectives				I			
Social Responsibility							
Personal & Professional Development	I	D	D	D	P	P	P

d. Please comment on the **sequencing of** opportunities for students to develop and achieve to ISLO proficiency within the program as appropriate, as noted on Curriculum Map II.

Except as noted below, the Computer Science courses are taken in sequence:

CSC101 Introduction to Computer Science
CSC151 Programming I
CSC252 Programming II
CSC253 Programming III
CSC257 Data Structures

Some students may skip CSC101 if they have previous programming experience and with permission of the teacher.

CSC156 Linux Fundamentals is not a sequenced course – it may be taken at any point in the program after the student has completed CSC101 Introduction to Computer Science or CSC151 Programming I. No subsequent class depends on it as a prerequisite.

CSC201 Assembly Language and Computer Organization may be taken any time after CSC252 Programming II, but no subsequent class depends on it as a prerequisite. Also, it does not require group projects.

The sequencing is appropriate for Knowledge & Skills, Critical Thinking, and Communication. Global Perspectives are introduced in Programming II through the Java Programming Language. This language became popular

with the advent of the World Wide Web because it was developed with the capability to be used globally, in all countries, with all languages.

Personal and Professional development learning objectives spiral through our curriculum, as students "learn how to learn" new programming languages. Students begin with Visual Basic, are introduced to a new language (C++) in Programming I. They learn a third language in Programming II (Java), and finally, during their second year, Assembly Language Programming. This is a critical element in the curriculum as all programmers must know how to update their skills when new programming languages arrive on the scene.

e. Please indicate on the following pages as appropriate **how each ISLO is supported to proficiency achievement within the program and how that achievement is assessed. Where ISLO achievement is directly supported by PSLO achievement, you can refer the reader back to that section in Question 7, rather than re-writing it.** If the strategy for attainment of an ISLO is contained within a particular course, please list the course first, with the relevant activity (or activities) listed next to each course. If there is nothing currently in place that is intended to provide for the attainment of a particular outcome or to assess the extent to which the outcome has been realized, please leave the appropriate space blank. The blanks will help to identify areas which need further development.

Communication

The MCC graduate will communicate, use information and employ technology effectively.

Graduates of the Computer Science Transfer Program will be able to communicate clearly, accurately, and succinctly through written and verbal means.

	CSC101	CSC156	CSC151	CSC252	CSC253	CSC256	CSC257
	Intro to CS	**Linux Fund.**	**Prog I**	**Prog II**	**Prog III**	**Assembly**	**Data Struct**
Communication	* Article/Web Summary * Research Paper *Essay Questions	*report *presentation *journal *Essay/lab Questions	*program prologue *essay questions *program comments *group presentation *code review	*program prologue *essay questions *program comments *group presentation *code review	*program prologue *essay questions *program comments *code review	*program prologue *essay questions *program comments * presentation	*program prologue *essay questions *program comments *group presentation *code review

- Describe how this Institutional Student Learning Outcome is **assessed for proficiency** at the **program level**.

To assess the Written Communication ISLO, we looked at Program Prologues, Program Comments, and Presentation reports. The Program Prologues are short, highly formatted prefaces to actual programming code that describe what the purpose of the program is, explain the history and nature of modifications to the program, and examine what areas the student found challenging and how these problems were solved. The program comments are short notes sprinkled throughout the program code that explain specific lines of programming code. The Presentation reports are the written products that are submitted in conjunction with presentation assignments that usually involve PowerPoint presentations.

For our assessment, we gathered 30 documents. We took 10 computer programs each from the Data Structures and Assembly Language classes (for a total of 20 computer programs). We took a full set for a given assignment for the entire class. Each of the three faculty members applied the same rubric to each of the 20 program documents. We also assessed 10 reports that were submitted for the Assembly Language course. The average score on the computer program communications was 6.82 out of a full score of 10. The average score on the reports was 69 out of 100. To assess the Verbal Communication PSLO, we took the parts of the professor's rubric from the group presentations of the Linux class that were relevant to this PSLO, namely the "Eye Contact" and "Presentation" scores. (The other parts of the rubric had to do with content and other items not directly related to the Communication PSLO.) The average score on these presentations was 6.53 out of a total score of 12.

What does the program's data analysis reveal about student achievement of this ISLO within the program?

The Computer Science curriculum is very dense -- it does not allow for oral presentations in the advanced courses generally taken in the last year. The students are assessed for oral communication in the middle of the program. In the Linux Fundamentals course student presentations were assessed for content and quality, as well as for eye contact and elocution. The average score for the latter was 6.53 out of 12. This suggests to us that more can be done to improve students understanding of what a good presentation entails.

See Appendix B for Assembly Language Report, Hardware Report, and Linux Fundamentals presentation rubric.

What curricular and/or instructional changes are planned within the program as a result of this data (if any)? Consider:

- **The scope and sequence of Introductory, Developing, and Proficiency level student learning opportunities**

- **The adequacy of the range of learning experiences and assessment methodologies that your program offers to meet student learning needs**

We have several recommendations geared towards improvement student achievement of this ISLO:

1. Show and discuss the rubric that will be used on the assignment with the students when the task is assigned.
2. Modify the rubric to reflect a better distribution of points that would match our criteria of a "good report".
3. Show a video of "good vs. bad" presentations skills to the students when the presentation projects are assigned.

We believe that our students need more experience with the type of presentation skills and written communication that will be required of them as Computer Science professionals. We will examine other opportunities in our courses for our students to practice these skills.

Additional Curricular Opportunities:

9. Please describe any interdisciplinary courses which are provided as an integral part of this program.

   There are no interdisciplinary courses that are required as part of this program. However, as an elective, CS students may be interested to take Computer Forensics courses, which will enhance their future marketability.

   During Summer 2008, Margie Bleichman and Carol Hay of the Math Department will be attending a week long workshop at Northeastern University with the goal of developing an interdisciplinary Math/Computer Science course.

10. Please comment on experiential/ work-based learning opportunities in the program (i.e., co-op, internships, service learning). Discuss how the content of the experience relates to course credit. How do you calculate the number of contact hours required in relationship to the credit awarded? What percent of students participate in each of these activities? Indicate any problem being faced in incorporating work-based learning.
    n/a

11. Please comment on the uniformity and appropriateness of content in multi-section courses and subsequent courses now in place. Do all courses have the proper prerequisites? Is the flow and relationship of courses to one another satisfactory? Are there changes indicated, based upon program objectives and/or new needs identified through the assessment process?

The faculty that teach multiple sections of a course, such as Introduction to Computer Science or Programming I, have chosen to use the same textbook. We also use some of the same teaching materials, such as PowerPoint slides, and have agreed to consistent requirements for program prologues and certain policies, so that the program will have a consistent feel across sections.

We have adjusted prerequisites for Introduction to Computer Science in the last couple of years to allow students to take it a semester earlier by allowing for Math and English co-requisites. The courses flow fairly well one to the other.

However, to ensure more success in advanced courses, we are considering two prerequisite changes:

1. Require Programming III or permission of instructor as a prerequisite for Data Structures. Currently students can take Data Structures after Programming II. Programming II is the first course in the Java programming language. For students with strong programming skills this has been fine. However, many students would greatly benefit from having two semesters of Java before taking the more rigorous Data Structures course, which is the most advanced of the Computer Science courses and requires that the student is proficient in Java programming. This prerequisite should be able to be overridden for stronger students and for students who must take Programming III and Data Structures concurrently in order to graduate that year.
2. Similar to the sequencing requirements of Mathematics courses, require a grade of C or better as a prerequisite to the subsequent Computer Science course, for the four courses that are sequence dependent:

   CSC101 Introduction to Computer Science
   CSC151 Programming I
   CSC252 Programming II
   CSC253 Programming III
   CSC257 Data Structures

   This change would also be aligned with the fact that students must earn a C- or better grade in a course in order for it to be counted towards their degree at UMass Lowell. Perhaps the sequencing prerequisite grade should thus be C- or better.

12. a. Please comment on the role of developmental courses in the program? Which ones are relied upon by significant numbers of students in the program? What conclusions are you able to draw about the impact of these courses on students' preparation levels?
    n/a

    b. Please comment on the role of developmental courses outside the program. Which courses in the program are relied upon by significant numbers of students, and which courses outside the program are relied upon by significant numbers of students? What conclusions are you able to draw about the impact of these courses on students' preparation levels?

Our student population has a smaller percentage that places into "Basic Writing" than the college as a whole and a larger percent who place into English Composition I. This indicates that we do not have to adjust the requirement for a co-requisite with English Composition I in our introductory programming class, Introduction to Computer Science. (The co-requisite is due to a Writing Intensive Value in this course.)

We do have a higher percent of students who place into Basic Writing ESL than the college as a whole (In 2005, 5 % versus 1.2 %.) This represents a very small percentage of our students, and may not be addressed directly by our department. However, we may want to begin to dialog with the ESL Department about our students, and how we can best assimilate them into our program.

In Fall 2005, as compared to the college as a whole, the Computer Science Department had fewer students who tested into "Required Reading" courses and more students who tested into "No Reading Courses".

A larger percentage of our students test into Algebra II and Intermediate Algebra than the college as a whole, while we have smaller numbers who test into Fundamentals of Mathematics, than the college as a whole. Since our students are very mathematically oriented, this statistic is easily understood.

c. In the event that there are admissions criteria for acceptance into the program, describe the rationale and process for establishing and reviewing the admission criteria. Do current criteria produce a pool of students who are adequately prepared to succeed in the program? n/a

13. Describe the array of instructional methodologies in required or elective courses. (e.g. face to face, online, hybrid, self-paced, experiential, inquiry/problem-based, case studies, projects, etc.)

Face to face, online, and hybrid are used in the program, as are kinesthetic techniques. All courses incorporate project based learning and are project oriented.

Section VI: Instructional Support

14. a. Please discuss the adequacy of the staffing level in the program to teach students enrolled in the program.

We have an adequate number of faculty and adjuncts to teach the numbers of student enrolled in the program.

b. Please discuss the adequacy of the staffing level in the program to advise students enrolled in the program.

We have an adequate number of faculty and adjuncts to advise the numbers of student enrolled in the program. We are attempting this year to have every CS major student be advised by one of the three full-time CS faculty members so that the specific nuances of the program can be communicated to the student early on in their studies.

15. What specific support services and activities (i.e., tutoring, media, library, disabled student support, computer labs, service learning) does this program require? Please comment on the availability and adequacy of these services. Be specific about any current deficiencies or projected needs.

    Tutoring is provided by the Academic Resources department. A professional tutor is available two days per week (one in Bedford, one in Lowell) and peer tutors are available on most days in both campuses. Adding an additional day each week on both campuses for the professional tutor would be ideal, but the current level of coverage appears to be adequate.

    Computer labs, in the past, have been available and our students made frequent use of them. Last year, however, those labs were closed to make more classroom and tutoring space. The library is now designated for this purpose. It is not adequate for our students, however, who need to use the equipment for long periods of time. Students have complained to our faculty, and the deans of CET and AR divisions about the fact it is difficult to find open computers. Without the ability to use school equipment, students are often forced to purchase software at considerable expense to use on their systems at home.

16. How adequate and appropriate are program facilities and equipment? Please be specific about current deficiencies or projected needs.

    There are lots of equipment problems on most PCs, such as slow switch power, improper USB driver, and fuzzy monitors in both Lowell and Bedford campus, except in rooms AR101 and LC201. The program requires computer classrooms that contain up to date software and hardware. This year, several classrooms were upgraded in Bedford with new computer equipment. These classrooms are sufficient to run our software. Other classrooms, however, without the new equipment are insufficient in terms of speed, stability, and reliability to suit the Integrated Development Environments (IDEs) of our programming languages. Slower equipment frustrates students and faculty as fewer problems can be covered during class time. At this time, not all of our programming courses are scheduled in the upgraded rooms. We need CS classes to be scheduled only into rooms with the newer equipment, or we need the rooms we are scheduled into to be upgraded to newer equipment.

17. Please describe any professional development needs of program faculty or staff.

Our professional development needs are ongoing. As soon as programming language modifications, environments, and techniques appear, we need to learn and implement them into the program. We will need to attend professional training workshops as the need arises.

18. Describe the sources of program funding. Are the funds adequate to support the program? Is the current use of funds effective to realize program goals? Does the program leadership have input into the program budget? n/a

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Please provide any additional information that you consider important in assessing this department/area.

Section VII: Program Evaluation Summary

This section should be completed based upon review and consideration of both the data supplied in **Section II** and the questions posed in **Sections III, IV, V, VI and VII.**

A. Program Strengths

Faculty

The Computer Science Department faculty engages in ongoing professional development, both technical and pedagogical. Since the previous Program Review, they have implemented new assessment, teaching, and learning methods into coursework. They have also added "soft skills", such as teaming, attitude, and performance, to their courses.

One faculty member is a Carnegie participant, too.

Collegial collaboration at MCC is continuing, with faculty developing courses for the CJ Program. Collaboration between MCC, UMass Lowell, and UMass Boston continues, too, as we seek to facilitate the transfer process for our students.

Faculty is active in STEM activities, as well. One member is focusing efforts on recruiting women into STEM courses. She has provided workshops to division meetings. These serve to heighten faculty awareness and provide ways to add more women to our program.

This semester, a faculty member is also piloting STEM study groups. These are facilitated by an adjunct faculty member. During the spring semester, the department will be evaluating the success of this initiative.

Pedagogy

The usage of technology in our classrooms is a great enhancement to the learning environment. Students are provided with a "hands on" learning experience. This experience allows students with various learning styles to participate successfully in the program.

While students engage in the learning experience at computer stations, faculty is able to continually assess student progress and skill-mastery, without waiting for project and exam scores. This enables our faculty to update the learning experience to cover areas that students are not grasping quickly, as well as provide one on one in-class tutoring for those who are struggling with a concept.

Tutoring

UMass Lowell, which does not provide an organized tutoring system, can lose up to 75% of their first semester computer science students. At MCC, our attrition is much smaller, partially due to tutoring efforts. Students are able to access peer and professional computer science tutors who help them hurdle difficult concepts. Faculty has seen the difference that this service provides to our students.

Student Contacts

Another inherent strength of our program is in its size and coursework. Because of its rigid course sequencing, students are able to quickly make contacts with other students, as they see each other in course after course, semester after semester. These contacts provide informal tutoring, encouragement, and an ongoing support system, which is invaluable to our students.

Facilitated Study Groups

The implementation of Facilitated Study Groups (FSG's) for an early course that many students struggle was very successful. The course with a well attended FSG had both a significantly higher retention rate and significantly fewer D and F grades than previous semesters of the same course. We recommend that FSG's continue to be funded and implemented for Computer Science courses.

B. Program Needs for Improvement, Proposed Plans for Improvements, Budgetary Implications, Timelines

Program Needs (Reference the question in the program review where this need is explained.)	**Proposed Plans for Improvement** (Bulleted list of suggestions.)	**Financial Needs to Make Improvements**	**Proposed Timelines for Implementation**
all courses scheduled only in computer classrooms with newer computers (Question VI-16)	. work with registrar's office to ensure appropriate CS classroom scheduling . upgrade 4 computer classrooms (2 on each campus) to faster processors. (figures courtesy of Joe Patuto)	0 18 computers/classroom x 4 classrooms x $600/ upgrade = $43,200	Ongoing Fall 2009
professional tutors scheduled more days per week (Question VI-15)	. schedule additional 16 hours per week (8 hours per campus) of professional Computer Science and Calculus tutors (figures courtesy of Jo Mucci)	$22.65/hour * 16hours/week * 32 weeks/year = $11,597/year	Fall 2008
professional training workshops and conferences (Section VI-17)	. find workshops relevant to Computer Science pedagogy . as workshops average about $1000, find sources of funding for extra $250 per person per year . request MCC funding	. each faculty can access up to $750/year in Professional Development Funds	2008-2009, as needed
fund and run FSG's for several CS courses (Section VII-A)	. continue LSAMP grant funding for FSG's . pilot FSG's in other CS courses	$1000 per semester to pay for facilitator of each FSG	ongoing
Better support high percentage of ESL students (Section III-3)	. begin dialog with ESL department faculty to generate ideas to support our CS students	0	
Improve student written communication (Section V-8)	. invite Writing specialists to present on writing skills to Intro to CS classes and other classes . incorporate more writing rubrics to show students what they are required to produce	0 (invite specialists from within MCC)	ongoing
Ensure more success in advanced courses (Section V-11)	. submit recommended new course and grade prerequisites to Curriculum Committee	0	Fall 2008

APPENDIX A
MCC Institutional Student Learning Outcomes

Knowledge and Skills

The MCC graduate will use knowledge acquired at MCC as a foundation for continued study and/or practical application.

- Freshman and sophomore foundation for transfer
- Professional skills for career track (degree or certificate)

Critical Thinking

The MCC graduate will demonstrate an ability to understand, interpret and analyze information in order to engage in critical thinking and problem-solving.

- Knowledge Acquisition, Comprehension, Application, Analysis, Synthesis, and Evaluation
- Quantitative and Scientific Reasoning
- Knowledge Integration, Reasoning, and Problem-Solving Across Disciplines

Communication

The MCC graduate will communicate, use information and employ technology effectively.

- Effective Written, Presentation and Numeracy Skills, AND
- Information Literacy and Technology Fluency

Global Perspectives

The MCC graduate will communicate an understanding of the world from a global perspective.

- Historical, Political, Economic and Social
- Scientific and Environmental
- Aesthetic Appreciation and Creativity

Social Responsibility

The MCC graduate will demonstrate social responsibility both within and outside of the classroom.

- Multicultural and Diversity Awareness
- Ethics, Values, and Social Justice
- Citizenship and Civic Engagement

Personal and Professional Development

The MCC graduate will demonstrate the capacity for on-going personal and professional development.

- Independent and Life-long Learning
- Professionalism and Accountability
- Collaboration
- Managing Responsibilities and Adapting to Change
- Initiative and Self-Advocacy
- Self Assessment

APPENDIX B:
Rubrics Used for PSLO Assessment

Rubric for Assembly Language Report

25 points	skeleton (introductory paragraph, supporting paragraphs, conclusion)
10 points	introductory paragraph(s)
5 points	introduces subject
5 points	explains what report will cover
50 points	supporting paragraphs
20 points	cite sources for topic
30 points	explain topics clearly
15 points	concluding paragraphs Summation of information that was presented in supporting paragraphs

Hardware Report Rubric

10 points	introduction

Topic Discussion:

40 points	describe hardware topic
40 points	explain types or versions

10 points	conclusion

Linux Presentation Rubric

Activity	Incomplete	Partially Proficient	Proficient	Exemplary	Points
	0	2	4	6	Total
Organization	Audience cannot understand presentation because there is no sequence of information.	Audience has difficulty following presentation because student jumps around.	Student presents information in logical sequence which audience can follow.	Student presents information in logical, interesting sequence which audience can follow.	
Subject Knowledge	Student does not have grasp of information; student cannot answer questions about subject.	Student is uncomfortable with information and is able to answer only rudimentary questions.	Student is at ease with expected answers to all questions, but fails to elaborate.	Student demonstrates full knowledge (more than required) by answering all class questions with explanations and elaboration.	
Graphics	Student uses superfluous graphics or no graphics	Student occasionally uses graphics that rarely support text and presentation.	Student's graphics relate to text and presentation.	Student's graphics explain and reinforce screen text and presentation.	
Mechanics	Student's presentation has four or more spelling errors and/or grammatical errors.	Presentation has three misspellings and/or grammatical errors.	Presentation has no more than two misspellings and/or grammatical errors.	Presentation has no misspellings or grammatical errors.	
Eye Contact	Student reads all of report with no eye contact.	Student occasionally uses eye contact, but still reads most of report.	Student maintains eye contact most of the time but frequently returns to notes.	Student maintains eye contact with audience, seldom returning to notes.	
Elocution	Student mumbles, incorrectly pronounces terms, and speaks too quietly for students in the back of class to hear.	Student's voice is low. Student incorrectly pronounces terms. Audience members have difficulty hearing presentation.	Student's voice is clear. Student pronounces most words correctly. Most audience members can hear presentation.	Student uses a clear voice and correct, precise pronunciation of terms so that all audience members can hear presentation.	
				Total Points:	/36

* Rubrics are adopt from http://school.discovery.com/schrockguide/assess.html

APPENDIX C:
Computer Science Department Student Questionnaire

Middlesex Community College
Computer Science Department
Student Questionnaire

Please take a few minutes to answers the following questions. Your answers will help us better support the Computer Science department at MCC and its students and to contact you in the future.

Today's Date:	
Course Name:	
Name:	
Address:	
Phone:	
Email:	
Major at MCC:	
Major at future college:	
Career goals:	
Will you be attending MCC next year?	
Will you be attending a 4 year college next year?	
If so, which one?	
Do you plan to graduate from MCC?	
If so, when?	
If not, why not?	
Are you transferring to a 4 year college without graduating from MCC?	
Has the MCC CS program prepared you for transfer into a Computer Science bachelor's degree program?	
Comments about the CS program at MCC:	

Comments about the Computer Science program from this Computer Science Student Survey included:

"It's a great program. Be better if some of the courses were offered all year long and in Lowell"
"Enjoyed it."
"All of the professors were knowledgeable and taught the material very well."
"Courses should be offered in every semester."
"Good, but could be more rigorous."
"I really enjoyed the material presented and the entire CS department staff has been very helpful along my way."
"I liked it."
"Excellent."
"I think the program is very well run."
"Feel lucky to be in CS."
"It is a good program. Prepared me to join university and continue my education."
"Friendly, nice."

APPENDIX D:

Computer Science Recruiting Flyer sent out Spring 2006: (next page)

LOOKING FOR AN EXCITING AND REWARDING FUTURE?
(not just a job?)

PICTURE YOURSELF AS A COMPUTER PROFESSIONAL!

ENROLL IN MCC's COMPUTER SCIENCE TRANSFER PROGRAM!

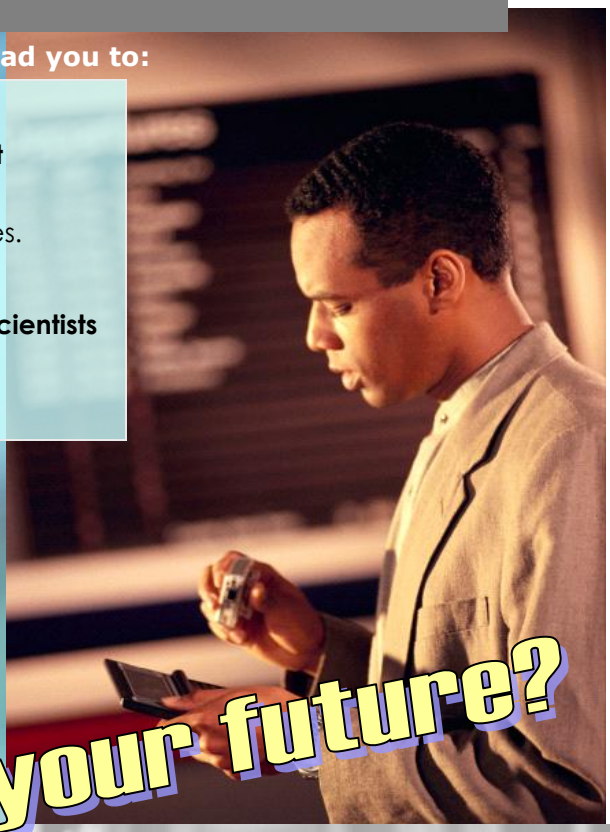
USE YOUR CREATIVITY! **a B.S. in Computer Science can lead you to:**

REWARDING CAREERS IN:

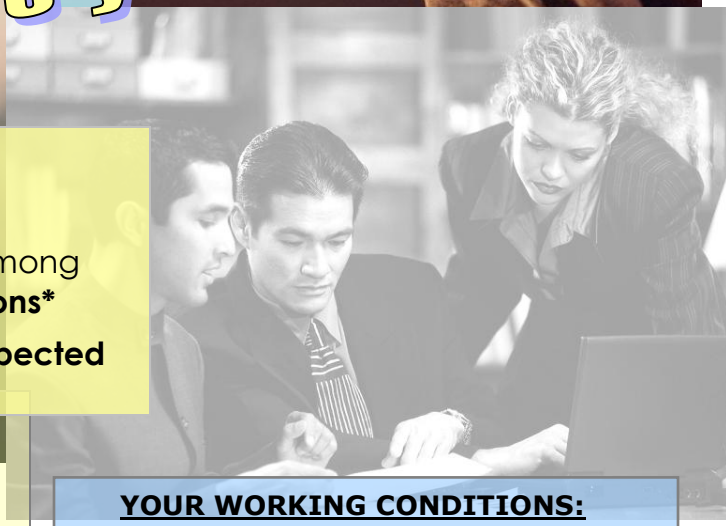
- **software, systems, database, security, networks, internet**
- or **springboard to interesting careers** in medicine, law, education, sciences, social sciences, and the humanities.

HIGH SALARIES:

- median annual earnings of **computer and information scientists were $85,190***
- the middle 50% **earned between $64,860 - $108,440***



how do YOU picture your future?



YOUR CAREER OUTLOOK:

in the next 8 years,

- Computer Scientists will be among the **fastest growing occupations***
- Employment in this area is **expected to increase by 12%***

YOUR COMPUTER SCIENCE PROGRAM:

- small class sizes
- supportive faculty
- free tutoring
- quality instruction
- state of the art software and computer labs

for more information on this exciting program, contact Margie Bleichman at bleichmanm@middlesex.mass.edu

YOUR WORKING CONDITIONS:

- work in an office or high tech lab in **comfortable surroundings.**
- work about **40 hours a week**
- **telecommute**: many companies allow you to do some or all of your work at home or other remote locations

* Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2006-07 Edition*